Robert L. Bates

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The Association of Geology Teachers
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The Editorial Committee consists of the editors of each of the regional sections of the Association of Geology Teachers, the national treasurer, and the Journal editor--William F. Read, Lawrence College, Appleton, Wis.

All persons interested in geological education are invited to contribute. Manuscripts should be addressed to the editor. Brief comments and discussion are also welcome.

THE ASSOCIATION OF GEOLOGY TEACHERS

Anyone concerned with geological education, formal or informal, and at any age level, is eligible for membership in the Association of Geology Teachers. Inquiries should be addressed to the national secretary, Dr. Ralph E. Digman, Harpur College, Endicott, N.Y.

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NOTES AND NEWS

National Association. Along with the May 15, 1953, issue of the "Transactions", Ralph Digman, our national secretary, has distributed copies of the national constitution as recently amended by mail vote of the membership. The effects of the amendments are briefly to (1) put the past-president of the preceding year on the Executive Committee (2) place the selection of the Journal editor in the hands of the Executive Committee (3) fix the normal term for the editorship at three years, and (4) turn over the management of Journal finances to the national treasurer. The present editor's term of office expires this year. The new editor will be announced at the November meeting of the National Association.

Central Section. The thirteenth annual meeting of the Central Section of the Association of Geology Teachers was held April 11, 1953, at Iowa State College in Ames. At the morning session, Professor A. G. Unklesbay discussed his course on the "History of Geology"; James G. Brice spoke on "Geology Laboratory for the Liberal Arts Student"; Chauncey D. Holmes discussed "A Course in Geology and Man"; and Katherine G. Nelson outlined "The Preparation and Presentation of a Half-Hour Television Program in Geology". After lunch a symposium was held on the teaching of mineralogy, with C. J. Roy, Percival Robertson, and W. F. Read as discussion leaders. This was followed by the business meeting. The evening session was introduced by a repeat showing of the "Colored Slide Symposium" presented by Dr. Robertson at the national meeting last November. The main address was given by Dr. George W. White of the University of Illinois on the subject "Geology in the American Colonies".

Eastern Section. The third annual meeting of the Eastern Section was held at Rensselaer Polytechnic Institute in Troy, New York, April 3-4, 1953. In the morning of the first day there was an excursion to the plant of the Gurley instrument company. At the after-

noon session, papers were presented by J. B. Lucke on "The Geology Teaching Crisis", J. G. Broughton on "The Relationship of the State Survey to Geology in Colleges", D. T. O'Connell on "The Training of Students at the City College for Graduate Work in Geology", A. Scott Warthin on "Water Conservation as a Geology Department Course", Donald B. Stone on "Earth Science in High Schools of New York State", Hugh Templeton and A. T. Collette on "Earth Science in Secondary Schools", Kurt E. Lowe on "A Practical Philosophy for Undergraduate Geology Teaching", and E. T. Apfel on "Let's Reorganize Geology Teaching". Following the papers there was a field excursion to points of geologic interest in the vicinity. A business session was held in the evening.

Additional papers presented on the morning of the second day were by R. T. Beers on "Amos Eaton", Ralph Digman on "Space Requirements of a Small Geology Department", Ralph J. Holmes on "Undergraduate Mineralogy at Columbia University", J. R. Dunn on "Plastic Teaching Aids for Optical Mineralogy", Milton T. Heald on "A Periodic Table of The Elements for Geologists", Julius Kaikow on "The Geology Field Trip as an Instrument of Conservation Education", and Freeman Foote on "The Organization of Material for an Introductory Course in Physical Geology". A colored slide symposium was held in the afternoon.

New England Section. The New England Section held its first annual meeting in conjunction with the Eastern Section at Troy, New York, April 3-4, 1953. (As noted in the preceding issue of the Journal, the New England Section was organized at Williams College on October 18, 1952.) A separate business session for members of the New England Section was held the evening of April 3rd.

East Central Section. The first annual meeting of the East-Central Section was held at the University of Cincinnati April 10-11, 1953. The program opened with a luncheon and business session. In the afternoon of the first day, the following general papers were

presented: "'Sea Monsters of the Past'--A Kodachrome Slide Series with Tape Recorder" by Mildred Marple; "Aftermath of a Radio Program" by Richard Goldthwait; "Recent Projects at Bowling Green University" by John R. Coash; "The Role of Amateur Geological Societies" by Charles Bacon; "Reaching 40,000 Children" by Ralph Dury, Director of the Cincinnati Museum of Natural History; and "What the Ohio State Survey is Doing for College Geology Departments" by Walter C. Brown. These were followed by a second set of papers constituting a symposium on the teaching of elementary geology: "Experience with a General Geology Course in Earth Science" by C. F. Moses; "Geology and the High Schools" by John L. Rich; "Elementary Geology--We Do It This Way" by R. H. Durrell; "A Method of Teaching Elementary Geology to Non-Majors" by E. C. Pirkle, Jr.; "Going Backwards" by K. E. Caster; and "Background Reading for Teachers of Elementary Geology" by C. L. Bieber. The elementary geology session was followed by a showing of colored slides. At the evening dinner, a brief message was presented by Dr. David M. Delo, President of the National Association, following which Dr. Richard Durrell of the University of Cincinnati gave an illustrated talk on "Cascade Volcanoes".

The second day of the meeting was taken up with an all-day field excursion to the Serpent Mound cryptovolcanic structure. In the late afternoon various members of the East-Central Section participated in a TV program over a Cincinnati station.

Eastern Conference on Earth Science Teaching. The fourth annual eastern Conference on the Teaching of Earth Science was held March 28, 1953, at the State Teachers College, Salem, Mass. The meeting was sponsored by the Earth Science Institute and the American Geological Institute. Attention was focused on the practical problems of teaching earth science in grades 1-9. (Previous meetings have been concerned primarily with earth science education at the "secondary school" level--grades 7-12.) After a short introductory address by Dr. Robert W. Webb of the American Geological Institute, papers were presented by Margaret

A. Shea of the Massachusetts State Department of Education; Joseph B. Smith, director of science education for the public schools of Salem, Mass.; Richard Sleeman of the State Teachers College, Castleton, Vt.; Miriam E. Dickey of the Children's Museum, Jamaica Plain, Mass.; David M. Seaman, associate curator of minerals, Harvard University Museum; and Mr. Arthur Socolow of the Dept. of Geology, Boston University.

In the afternoon session, additional papers were presented by Helen B. Ross of the State Teachers College, Fitchburg, Mass.; Robert Clemence of the Hyde School, Newton Highlands, Mass.; George Hosker of the Pearl St. School, Reading, Mass.; Ruth E. Jeffs of Bowditch School, Salem, Mass.; Thelma E. Wiley of Phillips School, Salem, Mass.; and Grace Dearborn of Weeks Junior High School, Newton, Mass. Demonstration class lessons for first, third, and fifth graders were presented by Dolores Fillacio, Nancy McGrath, and Thelma Spitz of Salem State Teachers College with the assistance of students from the Horace Mann Training School in Salem and the Hyde School at Newton Highlands.

Midwest Conference on Earth Science in Secondary Schools. The "Role of Earth Sciences in the General Education Curriculum of the Secondary School" was the topic for Group O of the Northern Illinois Congress of Classroom Teachers meeting at Northern Illinois State Teachers College March 7, 1953. (An earlier meeting on this same topic was held at the Lorado Taft Field Campus of N.I.S.T.C. in October, 1952, as reported in the Journal of Geological Education, Vol. 1, No. 4.). In a morning session papers were presented by Ben H. Wilson of Joliet Township High School and Joliet Junior College; Emery Frisch of East Rockford High School; and Mildred Morgan of Ottawa Township High School. In the afternoon, the speakers were Voris V. King, L. T. Caldwell, and George Stevens of Northern Illinois State Teachers College.

Conference in India on Training of Personnel for the Mineral Industries. Dr. A. K. Banerji of the Dept. of Geology, Presidency College, Calcutta, writes that a symposium on the "Training of Personnel for the Mineral Industry" was held under the auspices of the Mining, Geological, and Metallurgical Institute of India, October 10-11, 1952. In all, 77 papers were presented: 36 in the Mining Section, 25 in the Geology Section; 7 in the Metallurgy Section, and 9 in the Refractory Section. These papers are to be published in a special volume of the Transactions of the Institute. Persons interested should write to the Institute Secretary, Dr. P. K. Ghosh, at 27 Chowringhee Road, Calcutta 13.

19th International Geological Congress. We are indebted to Professor Hall Taylor of the Department of Geology, Columbia University, for the following enlightening account of the 19th International Geological Congress.

"The 19th International Geological Congress convened in Algiers, North Africa, Sept. 8-15, 1952, attracting approximately 1,000 geologists from all parts of the world. Highlights included excellent field trips both before and after the Congress, numerous papers on geological work in progress throughout the world, Russian protests at failure to accord their language equal rank with French and English at the Congress, and surprisingly excessive charges by Havas-Exprinter, tourist agency which arranged reservations for delegates.

"The field trips, which ranged in length from one day to three and a half weeks, offered opportunities to visit many important geologic features in Algeria, Tunisia, and Morocco. Participants found the trips well organized and for the most part intensely interesting.

"Papers and discussions at the Congress covered many areas of interest, but were channeled into fifteen principal sections: (1) pre-Cambrian correlations;

(2) Paleozoic rocks of North Africa; (3) rock deformation; (4) submarine sedimentation and topography; (5) fossil man; (6) genesis of vein rocks; (7) deserts; (8) groundwater in arid regions; (9) contributions of geophysics to geology; (10) iron ore deposits; (11) origin of phosphates; (12) applied geology; (13) general geology; (14) Near East oil fields; (15) tectonic influence of volcanism.

"Many papers, presented either in person or by abstract, described the results of current research. Some shed new light on topics included in many undergraduate geology courses, and a few discussed problems of geologic education. Included in the two latter groups were discussions of possible former land connections between Africa and America by K. E. Caster; of the development and significance of geosynclines by R. M. Field; of the granite problem by P. E. Eskola; of the formation of desert topography by P. Bellair, A. D. Howard, F. K. Morris, and others; and of ground water problems by numerous workers. A paleontologic teaching aid of proven value was described by R. C. Moore. Instead of assigning to students the time-consuming task of drawing pictures of many fossils, interest may be held and learning induced by supplying selected outline drawings, which may be mounted on cards, labeled, and studies in accordance with instructions supplied by the teacher.

"Abstracts of all papers appeared in the "Résumés des Communications". Later publication of the complete papers is planned. A series of guide books was published for areas covered by field trips.

"Delegates found living conditions in the capital city of Algiers comfortable, and the food with its mixture of native and European dishes interesting. Though more primitive accommodations appeared on many field trips, serious illness was rare, and few persons altered plans because of dysentery or other ailments.

"Many delegates experienced one annoyance. French law requires that hotel rates for rooms and meals be

posted. Comparison of these rates with charges made by Havas-Exprinter, travel agency which had reserved all available rooms, revealed amazing overcharges. One U. S. delegate, for instance, was billed 21,000 francs ($60) for accommodations for which the hotel charged 7,425 francs ($21). Only the threat of intervention by the American consul brought reduction by the agency of such "service" charges. For meals one of the luxury hotels had two identical menus, but prices were 25% higher on the one offered those wearing Congress badges.

"However, benefits of such an international meeting far outweigh the minor annoyances, and delegates agreed that a cordial vote of thanks was due the many scientists in Algiers and France who worked so assiduously to assure success of the Congress.

"Mexican geologists will be hosts at the next (20th) Congress to be held in Mexico City in 1956."

Earth Science Enrollments in Public High Schools. In view of the recent widespread concern among geology teachers over the status of geological instruction at the pre-college level, it seems desirable to present here in full certain data which have been quoted, or referred to, in part by various writers, including David M. Delo in the A.G.I. Newsletter for May, 1952 ("Earth Science in High Schools"), Ben H. Wilson in the November, 1952, issue of Ward's Natural Science Bulletin ("Earth Science Offers New Frontiers in Education"), and Ernst Cloos in the A.G.I. Newsletter for November, 1952 ("Why Have an Institute?"). These data are from "Offerings and Enrollments in High School Subjects, 1948-49", Chapter 5 of the "Biennial Survey of Education in the United States", 1948-50 issue, published by the U. S. Office of Education.

It will be clear from Table 1 that, while geology ("earth science") has practically disappeared as a separate high school course, the situation is not altogether desparate so long as geology receives its full share of attention in the "general science"

courses. The figures given are for grades 9-12 only. We should keep in mind that many schools offer "general science" at the seventh and eighth grade levels too. In 1948-49, for every 100 students taking general science in 9th grade, there were 47 taking it in seventh grade, and 61 taking it in eighth grade. A properly trained teacher could put across quite a bit of basic geology in these three years. Unfortunately any seeds of interest planted at this time are liable to die of starvation in the last three years of high school, when little or no opportunity for geological instruction exists.

TABLE 1

Enrollments, by Percentages, in Various Courses Offered in Grades 9-12 of Public High Schools of the United States, 1890 to 1949.

	Total enrollment	General Science	Earth Science	Geography	Physics	Chemistry
1890	202,963				22.8	10.1
1900	519,251		29.8		19.0	7.7
1910	739,143		21.0		14.6	6.9
1915	1,165,495		15.3		14.2	7.4
1922	2,155,460	18.3	4.5		8.9	7.4
1928	2,896,630	17.5	2.8	.3	6.8	7.1
1934	4,496,514	17.8	1.7	2.1	6.3	7.6
1949	5,399,452	20.8	.4	5.6	5.4	7.6

TABLE 2

Enrollments, by Percentages, in Various Courses Offered in Grades 9-12 of Public High Schools of Individual States, 1949.

	Total enrollment	General Science	Physical Science	Earth Science	Conservation	Geography
Alabama	108,141	25.7	--	--	.2	1.7
Arizona	25,221	9.3	--	.3	--	.4
Arkansas	70,787	25.9	--	--	.4	4.3
California	376,717	14.9	.7	.1	--	10.2
Colorado	49,485	13.3	.2	.4	--	2.5
Connecticut	64,023	20.2	--	.4	--	2.8
Delaware	10,309	16.4	--	--	--	6.8
Florida	85,240	18.6	.3	--	--	2.6
Georgia	118,180	26.0	--	--	.2	5.4
Idaho	29,373	18.9	--	.3	--	3.3
Illinois	298,927	24.1	.1	.4	.1	3.8
Indiana	157,364	1.0	.5	.3	--	3.3
Iowa	108,215	24.6	--	.1	--	4.6
Kansas	85,236	16.4	--	.2	--	3.8
Kentucky	86,441	21.3	--	.2	--	4.3
Louisiana	65,936	27.6	--	--	--	2.6
Maine	35,701	17.3	.2	.2	--	5.8
Maryland	59,687	30.2	--	.4	--	8.7
Massachusetts	155,684	21.2	--	.5	--	4.9
Michigan	221,247	10.8	.4	.3	.2	4.2
Minnesota	122,475	23.9	--	--	.2	1.6
Mississippi	67,519	18.5	--	--	--	11.2
Missouri	145,119	21.9	.4	.8	.1	5.6
Montana	25,244	15.0	--	.7	--	2.0
Nebraska	61,113	18.3	.1	--	.2	12.3
Nevada	5,755	19.4	--	--	--	1.1
New Hampshire	19,392	13.5	--	.5	--	.9

New Jersey	167,272	22.1	.1	.3	—	2.0
New Mexico	21,605	17.4	—	.3	.6	1.2
New York	520,747	29.1	—	1.6	—	14.2
North Carolina	150,834	18.1	—	—	—	4.8
North Dakota	28,940	24.8	—	.5	—	8.5
Ohio	286,095	21.5	.1	.2	.1	3.9
Oklahoma	109,866	21.3	.2	1.1	.4	7.0
Oregon	60,039	21.7	.3	—	—	10.5
Pennsylvania	402,064	25.8	—	.2	—	1.8
Rhode Island	22,395	22.4	—	—	—	7.1
South Carolina	70,467	25.2	—	—	—	2.8
South Dakota	28,918	23.1	—	.1	—	7.0
Tennessee	106,449	23.3	—	.5	—	5.3
Texas	263,118	17.6	—	.1	—	2.8
Utah	37,395	13.1	—	.6	—	9.2
Vermont	12,079	20.0	—	.1	—	3.6
Virginia	110,582	26.9	—	.3	—	4.2
Washington	88,279	12.8	.1	.1	.1	3.4
West Virginia	85,343	16.8	.1	.1	—	3.6
Wisconsin	135,219	20.0	—	.5	.3	7.3
Wyoming	13,278	14.4	—	.5	—	1.6
Dist. Columbia	19,847	11.7	—	—	—	9.2
National	5,399,452	20.8	.1	.4	.1	5.6

THE COLLEGE GEOLOGY TEACHER[1]

Charles H. Behre, Jr.
Columbia University

Prologue

When your program chairman invited me to air my views on the teaching of geology in the American Arts College, I rushed into acceptance with all the willingness of a small-apartment dog to whom his master shows the leash that bespeaks a promenade. Your chairman tactfully suggested that I select the title. Waxing humorous, I chose something that would connect the climate--intellectual, not meteorological--of the American college with its effect on the teacher of geology. Latter--too much later--came sober second thoughts. My own career, though that of a teacher, had involved no college teaching worth mentioning. I had first taught geology in its applied phases mainly, and my charges had been chiefly students in various branches of engineering. In later years they had been men and women who had passed the undergraduate days of outward confidence and inner questioning and had moved upward into the level of professional geology, where all is questionable. So I had become progressively less informed on the problems of the college--and in fact, as I moved from college to graduate school, less informed generally. What could I say of interest to the college teacher of geology?

Lest this suggests that I would pass by my friends in the colleges with the sideward glance of condescension, I hasten to say that in my opinion the serious, devoted, able college teacher is the salt of the earth, ranking, if possible, about on the level of a better-than-average angel. He is generally the best informed, most widely read, and most human of geologists--and that is saying a great deal. Moreover,

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[1]Presented at the national meeting, Association of Geology Teachers, Boston, November 15, 1952.

he usually avoids priggishness of all forms--the authoritarian tone affected by some professors in the graduate schools, that superficial judgment which the technical school teacher is tempted to adopt, the velvety ostentation that marks many a successful consultant, and the coldly reserved assurance of some men on the various surveys. These traits of overweening self-confidence are generally lacking among college teachers of geology, for constant and informal association with the younger folk, adept at dismantling pedestals, reenforces the modest temperament of the college professor and keeps him below his rightful place in society and among geologists. Therefore, I am very happy here and now publicly to salute the good college geology teacher with a most respectful bow.

On continued thinking about his role, I have come more and more to the conclusion that the college teacher, unlike his friends in the technical institutions and the graduate schools of geology, is faced with a peculiar situation that tends to sap his energy and give him a sense of frustration under which his obligation can only be half discharged. That situation is one for which his environment is fundamentally to blame. As we all are a part of that environment we share that blame in large measure.

It is my purpose then briefly to discuss three things: (1) what are the qualifications of the individual that go with success (in the best sense of the word) in teaching geology in college? (2) why is the job so exceptionally difficult? and (3) what can we do to alleviate--or, better yet, improve--matters?

What He Should Be

What serves to mark off the ideal college teacher of geology, as distinct from the mere average? In a measure, ideal college teaching is, like godliness, a state of mind and not a profession. Thus much of what one might say applies to all good teachers--whether of the history of music or college algebra. But certain common qualities can be at least listed,

even if not necessarily in the order of their importance.

Enthusiasm. The college teacher must aim to be a "great" teacher--stimulating and exciting. The possession of "greatness" is something understood, even though indefinable, and, if present, is agreed upon by most of a man's students, if not by all. It seems to be a compendium of several differing qualities. Perhaps the outstandingly important of these is enthusiasm. For years, in field work, I have conducted among my younger associates an unpretentious private census, to learn who, among each faculty, has been a great influence, and why. Invariably a prominent place is accorded to enthusiasm, gusto--the quality that such otherwise diverse men as W. H. Emmons, James Perrin Smith, and Kirk Bryan appear to have had in common--colored, of course, by the distinctive flavor of each positive character.

Skill in speaking. With enthusiasm usually goes, in the college, the capacity for vivid expression and clear speech. The scientist or technologist may be so highly creative or variously informed that the graduate and engineering student and even the professionally far-advanced college undergraduate will listen with rapt attention no matter how much the speaker garbles his formulae or, in Fenneman's dramatic phrase, "vocalizes between thoughts". But the college undergraduate puts competence in speech on a par with other qualifications and if the speaker cannot convey his ideas with some clarity and color, the student is frankly resentful. The college student feels that such special techniques as illustrative free-hand sketching and the "fading in" of lantern slides are admirable adjuncts but do not really compensate for ineptness on the podium.

Apperception. Thirdly (or perhaps the order is wrong and I should say secondly) patience and tolerance--those adjoining windows for looking fairly upon the world--appear to be qualities necessary for outstanding contributions as a college teacher. The

great teacher's memory or his apperception--one is never sure which--, is unusually capable at sensing the perplexities of the beginner. Thus he can take the student easily through the fens, and out upon the road again.

Extra-curricular interests and skills. But presiding in the class, field, and laboratory--are these the limits of the college geology teacher's work? Of course not. The college has "extra-curricular" activities for teacher as well as student. The teacher's "noblesse oblige" leads him out of his own office and into problems that he seldom anticipated--advice to the lovelorn, council on choice of career, and even concrete financial support, sometimes to the serious thinning of his own flimsy pocketbook.

Content. I was far from intending by what has gone before to underrate the important role of college geology teaching by which it may set for the student the standard of logical, objective thinking. Among the sciences, geology affords a distinctive discipline because it is not a fundamental science but rather an apical one, based largely upon other sciences. It combines the quantitative and relatively clear-cut reasoning of physics, chemistry, and mathematics (as in geochemistry and crystallography) with the more descriptive data and the more pragmatic judgments called for in such problems as biologic evolution, petrogenesis, and continental development. It is good that the maturing college student should be brought into touch with both of these two somewhat differing kinds of thought. Geology can be used to give him general confidence in the scientific method but it can also serve to show the limitations, the tentative nature, of most large conclusions. The student of geology should gain the recognition, with Josh Billings, that "'Tain't the not knowin' that adds so much to the sum of human ignorance as the knowin' of things that ain't so."

In my opinion these two operating principles--factual empiricism and conscious tentativeness--which

at first appear in conflict but are basic to the thinking methods of most geologists, are the most important broader concepts that the student in the liberal arts college can derive from his schooling. Certain other, somewhat lesser, but basic philosophic ideas of special value to the maturing thinker also suggest themselves to all familiar with our science: the awesome extent of geologic time, and the calming recognition that world-wide cataclysmic changes did not take place but that there was instead a very steady, gradual evolution of the earth.

Contact with the science. I need hardly add that all of these qualities of the good teacher are greatly aided by his interest in some field or laboratory problem. The good college teacher need not, in my opinion, be an outstanding research worker, but he must be enough of a continuing scholar to keep in close touch with his subject. The likelihood that he will be a great teacher will be very much enhanced if he does have the fervor that goes with independent thinking in his science, especially if his teaching does not too greatly interfere with research, nor his research with teaching. Unfortunately the heavy schedules of many college teachers preclude devotion of many of their days to research. This is a problem which I commend to administrators. There is, of course, the teacher whose door is "always open to students" to the point where the maturing student fails to comprehend the need for regularity and discipline in the lives of others. After all, the young man should not be encouraged to regard the teacher's office as a public house. A practice too liberal in this matter in the undergraduate years may fix among the alumni the impression that the teachers' time is a valueless commodity!

Yet another unfortunate deterrent from research is the fact that field study and laboratory equipment are heavy drains upon the salaries of college teachers, which are always low, and now, under the impact of rising living cost, are even less adapted than in the recent past to modest professional expenditures. Here

again is a major problem for the realistic college executive.

What Confronts Him

The personal traits of the great teacher, however, are obviously not the sole factors that determine his success. The environment, the "climate" that surrounds him, is equally important. And it is a peculiarity of this environment in the American college, as distinct from the technical school and the graduate school, that raises special difficulties for the college teacher of geology. These difficulties are not inherent in the subject, geology, but rather in the spirit of colleges throughout this country. As Artemus Ward would say, "Why is this thus? What is the cause of this thusness?"

Conflicting purposes. By far the most serious hurdle arises from the fact that the American college has not clearly decided what is the major purpose which it is to serve. This is true for the teacher. It applies equally to his dean or president--forced, so often, into a kind of opportunism by the need to raise endowment funds. How still more vague must be the ideas of boards of trustees and of the public at large! The root of the difficulty is typically American.

In practice, as distinct from theory, the American college really has to serve many different masters, each shrilly insistent upon its own objectives.

No one expects schools of engineering, schools of mines, or departments of applied geology to undertake the infusion of a conspicuously liberal vision into the viewpoint of their students. Such technical schools may do what they can by way of introducing to the undergraduate the broader, less specialized aspects of his career, such as his position in society or the interrelation of the peoples of the world. In many cases this approach may achieve considerable success, but the standing of the school is, naturally,

based upon the capability of its products as technical men. In this the technical school differs but little from the graduate school of geology. These two educational units fill the roles of the continental European "Technische Hochschule" or "École des Ingenieurs" on the one hand and of the University on the other. Both are really at bottom professional schools.

The American college, by contrast, is expected to serve four different purposes, and, whether we like it or not, those who attend have correspondingly conflicting objectives.

(1) Many genuinely desire to acquire a broad view of human thought. They come, not for training as specialists, but for acquaintance with the basic sciences, with social trends, the arts, philosophy, as these things are today and in their historical development. This is perhaps the most central objective for which most of the older American colleges were founded, and it is usually written, in one form or another, into the deed of gift or charter of foundation. It is laudable and, in the writer's opinion, it is justified in this country where there is only a small leisure class. This objective of the college has contributed, more than any other, to the broadening of the national horizons--far more, it appears, than radio or television, newspaper or magazine. The likelihood is that the "cultural" influence of the college will increase, what with the steady rise in college and university enrollment. The continued increase in attendance at our largest state and municipal universities is conspicuously made up of students at the college level.[2]

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[2]During the twelve-year period from 1939-40 to 1951-52 enrollment in the Liberal Arts College of the University of California increased from 18,478 to 26,869. At the College of the University of Illinois the increase was from 4,743 to 7,719; at New York University, 6,922 to 11,418; at Ohio State, 3,599 to 6,008; and at the University of Minnesota, 7,484 to 9,183. Data kindly supplied by Rose M. Smith, Statistician, U. S. Office of Education.

These registrants have as their primary aim a laudable desire to "look around", though this purpose is not too well defined and usually undergoes a slow and steady change as the student advances. In France and Germany there is little in the universities and technical schools that corresponds to this ideal; it is best expressed by the older British universities, such as Oxford, Cambridge, and their "silent sister", at their undergraduate, non-professional levels. We in geology are generally less conscious that this purpose may be served than are the social scientists, linguists, and philosophers.

(2) A different objective, but still a kind of corollary of this "cultural" viewpoint is the use of the first four college years--whether in the small college or the large university--as a period of maturing the individual. This is a function that I, for one, resent but cannot see a way of effectively opposing at this time. It was severely criticized by Dean Max McConn in one of his books, "College or Kindergarten?". As an objective, it is stressed more by the parents than by the teachers or the students. Perhaps a realization that people may have to be "put away" to ripen is implied in the use of the word "institution" to describe a college! Yet despite such inuendoes, is it not desirable that there should be, in the present stage of social and intellectual development in this country, such a maturing <u>when conducted under the right auspices</u>? In the European pattern this maturing is accomplished, if at all, in the secondary schools. More might be done at the same level in the United States but for the unfortunate stress in our country upon the cultivation of the "personality" during that period of the individual's life, at the expense of both knowledge and character.

(3) A third duty into which our colleges have been forced, at least in some measure, is early professional training. Many of the eastern men's colleges and at least one woman's college of which I know, were avowedly founded to train young people for the ministry or for missionary work. Despite a change from this

objective, the students themselves have insisted on the introduction of other professional training at the college level. The college has thus come to compete, albeit in a somewhat less intensive way, with the graduate and technical schools.

(4) Finally, there is the fact that many students enroll in the American college in the hope that they may become "oriented" toward a profession--which may, of course, include geology. Like each of the other objectives, this last may grade into any of the others for a given student.

Thus it is apparent that the American college, as an educational organ, has four different purposes--a source of non-professional culture, a way-station in growing up, a junior professional school, and an orientation medium for those searching for a profession. Young people who fortunately come from families which already have a high cultural tradition can dispense with the first of these. Those so constituted that they mature earlier than their classmates need nothing of the second. Still others already have their minds made up as to their professional objectives--though it is surprising how often their early decisions have to be revised and how few young people are ready, as late as in their third college year, to commit themselves to a field as broad as geology, a choice much less specific than, say, paleontology or mineralogy. Thus, one who later became an outstanding geologist, first tried psychology; several have gone a way in medicine before changing their minds; one that I know started life as a lawyer --and one ended it in that strange career.

Whether or not we decry this relatively planless procedure for acquiring the geologists of the next generation, it is here, for the present at least.

A suggested pre-professional curriculum. Even in history and the languages the college initiates and recruits to the ranks of the professional. In geology, where professional opportunities are speedily

expanding--thanks to federal and state work and to professional outlets in petroleum, mining, and engineering geology--professional orientation and pre-professional training, like the other two purposes of the college, must, in my opinion, be taken care of. I propose to consider below some measures looking in that direction.

Why should it be a case of "all or nothing" as regards early professionalism in geology in the college? If the possibility of pre-professional training is not expressly anticipated in the curriculum, the student is faced with the difficulty of patching together such a curriculum for himself, and he may do so very poorly indeed. The curriculum must contain pertinent introductory courses in geology and the background subjects which all of us seem to agree are desirable; at the same time it cannot infringe upon the college rules as to electives and especially as to dispersion of fields of study in the earlier college years. This problem does not seem insurmountable.

Assuming five 3-hour courses, or their equivalents, per year and a 4-year plan, the pre-professional liberal arts college student might follow a curriculum about like this:

First Year

Modern Language I
English
Natural Science
Mathematics
Social Science

Second Year

Modern Language II
Geology (physical-historical)
Chemistry
Biology
Social Science

Third Year
Modern Language II
Geology (mineralogy-petrology)
Physics
Geology (structural)
Elective

Fourth Year
Geology (paleontology)
Geology (techniques)
Geology (economic)
Chemistry, Physics, or Biology
Elective

If necessary, the first year courses could be largely "orientational" to satisfy the administration. The program outlined provides for a little of two languages, assuming that a slight background already exists for one language from high school training. Time is assigned to a second year of an elective basic science--that is, a science other than geology, and for further electives in the junior and senior years. An anticipated difficulty is the heavy load of the beginning sciences, especially in the sophomore year.

Defects in pre-professional curricula. As a basic adviser to the graduate students in geology at Columbia University, it has been my duty to review the kinds of backgrounds with which undergraduate students enter their post-graduate professional work. Interestingly enough, some of the most broadly based seem to be graduates from the Canadian colleges. In the curricula from American colleges one phase of background conspicuously lacking is biology. The absence of recognition that botany and especially zoology furnish a necessary base for understanding the geologic record of life, is reflected in the discussions of geologic training sponsored in recent years by the Geological Society of America. These discussions have tended to put all the emphasis on physical sciences. The paleontologists now teaching in the colleges could aid in setting a new trend by demanding more biology of their students.

An equally important omission has to do with economic geology. Some of the more descriptive facets of this subject, because of their bearing upon the political and industrial world, should clearly be included in the early basic undergraduate training for all persons who touch geology. The bearing of geology on the Stalingrad campaign, on the settling of South Africa, and on the present conflict between Iran and Britain are examples easily thought of. Yet there appears to be a strange and progressive tendency to omit the applications from the undergraduate curriculum.

A third justifiable criticism of geology as presented in some colleges relates to the over-emphasis upon its technical content. To gain some understanding of what geology does mean to most who study it for "culture" or for love of the subject, it is only necessary to ask other geologists, old or young, "Why did you first think of entering geology?" Essentially, most of the replies are, "Because it is an out-door subject." I am convinced that this remains the outstanding general reward for the amateur and perhaps even for the seasoned professional. Why "play it down"? Geology represents the last frontier among the natural sciences that once carried the observer into the field; for even biology, as now studied, offers little of such experience. It is not necessary to live near the Yellowstone for this point to be appreciated. Only some skill and enthusiasm on the part of the field leader are needed to give pleasure to almost any natural setting, in its geology and its wild life. The success of the field trips of the Illinois Geological Survey, attended by an average of 75 persons for six trips a year since 1927,[3] illustrates effective leadership of this sort.

Finally, the particular color that geology has in a given college is lent by individual courses and over-all curriculum and should be reviewed periodically

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[3]Leighton, M. M., Chief, Illinois Geological Survey, personal letter, 1952.

by the geologic faculty in that college. Thus strong points may be balanced and weaknesses removed.

Summer field experience. Most of the elements mentioned as unfavorable to geology in the college setting have had to do with the internal structure or the avowed aims of the college curriculum. I come now to a third aspect of weakness in which the outside world, and particularly the practising but non-teaching geologists, can lend a necessary hand: the failure to supply pre-professional experience at the college level. Assuming the student does wish either to test out, or to commit himself to, a geologic career, how step out of the classroom and into the field?

First, of course, there are summer field trips, offered by colleges from coast to coast. One summer, or conceivably two, might be devoted to these. Suppose this to fall at the end of the first and second years, what then? In state universities, with a strong geological survey attached, an outlet is available for experience under direction in a field party, in which the young trainee can gain in knowledge and perhaps earn a small fee besides--possibly the deciding factor in his return to college. In privately endowed universities, however, and in most small colleges, such opportunities are far fewer. By contrast, Canada (admittedly under-supplied with geology students, but also a much less wealthy country) has had a regular policy of 45 years' standing for using students as summer field assistants on its surveys, beginning with the freshman or, at latest, the sophomore year in college.[4] Many of us who are teachers had hoped that a similar plan could be adopted by the United States Geological Survey, on at least a modest scale, but nothing has yet been forthcoming.

It is to the best interests of the mineral industries likewise to develop a good-sized group of beginners,

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[4]Hanson, George, Chief Geologist, Canadian Geological Survey, personal letter, 1952.

competent either in mining or in petroleum exploration. Yet each company, operating by itself and forced to charge such costs against its own budget, hesitates to embark on a program of student training similar to that here advocated for the Federal Survey.

In this field, such influential groups as the American Institute of Mining and Metallurgical Engineers, the American Association of Petroleum Geologists, and the Geological Society of America could be very, very useful by directing attention to the desirability of cooperation and conceivably acting as a channelway--as the American Chemical Society has long done with students in chemistry and chemical engineering.

What Can Be Done To Help Him

From the preceding discussion I hope it is clear that we of the profession, both in and out of college, can take certain steps in order to aid in the college teaching of geology. Such steps would reflect in no way upon the capacity of as effective a group of teachers as we have in this country--the college teacher. On the contrary, they would greatly help a good cause.

The steps that seem especially and immediately merited are the following:

1. To retain the enthusiasm and esprit of the teacher as such, an attempt should be made to endow and award at regular intervals a suitable national prize. The recipient should be an outstanding contributor to the college teaching of geology.

2. To help maintain before the eyes of the college teacher the connection between teaching and continued research, thus supplying the tonic that stimulates good teaching, a practical plan should be worked out for subsidizing desirable field and laboratory research. This should be designed especially to aid the college teacher who may

otherwise suffer in competition for such aid.

3. Special efforts might well be directed, perhaps by the Association of Geology Teachers through a standing Committee on Curricula, toward serving the essential purposes of our college curricula as related to geology. Such work should stress the need in the college for the development of the most purposeful, but also the most flexible curriculum, designed to meet the highly varied requirements of the American college student.

4. To serve especially in preparing the pre-professional student, who, though still an undergraduate, plans to enter a graduate school for advanced study, such a Committee on Curricula might also consider the actual design of course sequences for pre-professional college students, and might then publish its conclusions as a guide to colleges. It should be possible for the Committee to draft a plan suited to the framework of the average moderate-sized college and covering the essential basic studies and fundamental techniques, while still retaining the requirements prescribed by most colleges. The whole could be flavored with a dash of electives, as desired.

5. Finally, this, or a kindred organization, might re-examine means for on-the-job summer experience, analagous to that used by the Canadian Geological Survey or the "co-op" plan of Antioch and the University of Cincinnati. A procedure might even be devised to induce industry and government surveys to cooperate in such an undertaking.

TEACHER, TEXT, AND STUDENT

Chauncey D. Holmes
University of Missouri

Most college courses today have an "adopted" text, and this is especially true of undergraduate courses in geology. So nearly universal is this practice that the place and function of the text are taken for granted, and almost no one raises the old question as to whether textbooks are an asset or a liability in college teaching. However, the basic significance of the question should not be forgotten. After all, why have a textbook?

Teachers' answers to this question are varied. Some teachers look for a text containing all the information needed in the course, and on which the student will be examined and graded at the end on the semester. Assignments are made regularly. The teacher does not necessarily lecture on the subject matter of the assignments or discuss them in class meetings. He fills in his time as best suits his mood and the occasion. Other teachers require a text but give no specific assignments. They depend entirely on the student to read the text material bearing on the several topics covered in lectures. The essential difference between these two extreme attitudes is that in the one case the textbook determines the course content, whereas in the other the teacher himself selects and organizes the subject matter. Most teachers probably follow some modification of the first procedure. They give carefully planned assignments, followed by some form of systematic class discussion.

No teacher would disagree with the idea that the purpose of the text is to aid the student in achieving mastery of the subject. There are, however, some pitfalls in regard to the selection of textbooks which many teachers overlook and which the students cannot see until too late (if at all). One of these pitfalls lies in the fact that some texts contain considerably

more material than can be covered in the course. Because most textbooks are written to sell, many authors have given prime consideration to those ideas likely to appeal to the teacher who is choosing the text, rather than to the student whom the text is supposed to aid. The teacher, in turn, often feels that his course will be more highly regarded by his colleagues if he chooses a "rigorous" text--one that is long and difficult. Rigid selection by the teacher of pages and paragraphs to be omitted is seldom feasible, and the student does not have the necessary background to do this for himself. Since he is continually faced with more material than he can master, a sense of frustration constantly handicaps his efforts and may finally stifle any eagerness to learn. Student apathy resulting from the use of an unsuitable text is quite likely to be mistaken for laziness and treated accordingly. Thus the teacher inadvertently adds insult to injury. The student, never having approached the subject in any other way, cannot be fully aware of the cause of his distress.

No text seems to have just the right amount and right selection of subject matter to satisfy all instructors, but especially in an introductory course, it is far less hazardous to use a text that may require occasional supplementing.

The "ideal" textbook that "has everything" for a particular course has, by virtue of its very perfection, a deadly disadvantage. It leaves nothing essential for the teacher to do. Such texts have developed out of popular and worthwhile courses originated by able teachers. Putting the course material into textbook form has destroyed the popularity and effectiveness of several courses known to the writer. It is doubtful whether vital teaching can be done without constant and essential contributions from the teachers.

Another type of concealed pitfall lies in the use of large and complete elementary textbooks in "second" courses. If the student has done his briefer elementary course well, he is likely to be irked by an

elementary-type approach to further study in his subject. In making the rounds again of already-familiar concepts, he may begin to wonder why there is so much duplication of his earlier work. He feels that he is repeating material he has already learned. All this tends to obscure the new and more advanced ideas on which he should be concentrating. The still-elementary atmosphere of the text in such situations dulls his sense of earlier achievement and lacks the challenge of clear focus on what, for him, should constitute advanced work. There is at present a dearth of good texts for "second" geology courses designed to follow a brief but comprehensive introductory course.

There are two types of text material which require definite and vital contribution from the teacher, and virtually all texts contain some material of each type. One is material with some notable errors, or omission of important subject matter. In assignments, the student can be warned to be on the lookout for, or questions can be raised that will point out, such errors and omissions. Then in class discussion later, these shortcomings can be fully evaluated. This procedure helps greatly in developing in students a judicious attitude toward books in general, and, it is hoped, a charitable but carefully considered final verdict on the worth of the particular text. While a text is probably never selected because of its shortcomings, the skillful teacher can nevertheless use such imperfections to powerful advantage, provided that they are not too numerous.

The second type of text material requiring help from the teacher is that which presents a reasonably accurate and well selected body of fact but which does not lead the student step-by-step through all the reasoning by which the conclusions have been established. This, then, is the teacher's task. It affords him an opportunity--in a most opportune setting--to demonstrate the weighing of evidence, and the art of geologic inference and deduction. For the student, this type of text is ideal for gaining a comprehensive view of the course. Satisfied through

classroom discussion that the stated conclusions are logically drawn, he can review a maximum amount of course material in a minimum amount of time--the optimum situation for perceiving interrelationships among the several aspects of the course. The text that attempts to lead him by the hand through all the primary reasoning becomes unnecessarily cumbersome for review. It obscures the "new view" which the review should afford. It doubtless serves a useful purpose for some students; for others it may be too detailed; and for still others, too obscure. Such texts may be advantageous in preparation for classes conducted largely by the dubious question-and-recitation method, but much leading-by-the-hand encourages an undesirable attitude of dependence on the text, rather than independent exercise and training of the imagination. Where the teacher is the guide in the necessary logic, he can adapt his methods to the immediate needs of his class. This is one of the most vital aspects of science teaching. Personal guidance by the teacher is more effective than that of the printed page.

Especially in selecting an elementary text, the teacher will do well to guard against the common error of thinking of student needs largely in terms of the hoped-for major, who constitutes perhaps five percent of an average elementary class. The present writer shares with an increasing number of able teachers the belief that our science can be most effectively promoted by improving our service to the non-majors. That they fare as well as they do in some situations is due largely to the broad appeal inherent in the subject matter of geology.

In summary: (1) the teacher should know his students' needs, limitations, and possibilities, and should select a text on this basis alone; (2) the text should not circumscribe the aims and ideals of the course; (3) the teacher must discover and circumvent the factors that limit the usefulness of the text for his students, for no text is perfect; and (4) the teacher should reserve for himself some kind of continuing, vital contribution. Without this, the student may as well take the course <u>in absentia</u>.

GEOLOGIC EDUCATION IN SECONDARY SCHOOLS OF NEW YORK STATE: DIFFICULTIES AND SUGGESTIONS[1]

Ralph E. Digman
Harpur College

I think we all agree that geological training at the high school level is a good thing. If every science-inclined student of high school age were given the opportunity to take a course in geology under an adequately trained teacher, the caliber of college geology majors would markedly increase. Only after such a situation is brought about in our high schools, will college geology receive its fair share of scientifically inclined entering students. The desire to continue study in the field of an inspiring teacher is perhaps stronger on the part of high school students that it is among college students. Increased teaching of geology at the high school level would benefit the geological profession as a whole because more high-caliber students, having received an early introduction to geology, would consider this field as a vocation. In addition there would be a far-reaching improvement in public appreciation of earth science and the work of the earth scientist.

In New York State, geology (or "Earth Science") is offered in many secondary schools as a one-year elective at the senior high school level. From letters sent to high school supervisors in the east (only a few responded) I learned that the New York picture is far better than that of neighboring states. In West Virginia geology is suggested as an elective in the science field for a maximum of four semester hours, but few schools have offered it. In New Jersey a unit of geology is taught, as a rule, in the general science course required in ninth grade, and one high

[1]Presented at first annual meeting of the Eastern Section, Association of Geology Teachers, Lafayette College, Easton, Pa., April 20-21, 1951.

school offers a separate course in geology. In Pennsylvania, as in many other states, one unit of geology is offered in the general science course.

The traditional high school science program consisting of general science, biology, chemistry, and physics in successive years is firmly established. The possibility of adding geology as a fifth science is unlikely so long as pressure continues for expansion in the fields of social studies, business, and manual arts. In New York State, in recent years, earth science may be substituted for general science at the 9th grade level. Few science teachers are qualified to give the course and few high school administrators feel that they can budget the required sums for books and teaching materials to make the earth science alternative a reality.

Despite geology's weak position in the curriculum, we are told that the years 1946 to 1950 showed a five-fold enrollment increase in high school earth science courses as evidenced by the number of Regents examination papers written in this subject. An important reason for this increase in earth science, according to Mr. Hugh Templeton, Supervisor of Science in the New York State Education Department, is that many science teachers were trained in meteorology during World War II. If this is true, the five-fold increase in earth science does not imply a corresponding increase in the total quantity of geology taught as compared with other aspects of earth science (meteorology and astronomy).

The total of 7500 Regents examinations written in earth science in 1950 is to be compared with totals for the same year of 25,000 in physics, 35,000 in chemistry, and 60,000 in biology. Recent New York State College Board and scholarship examinations contained more questions on earth science than any other science. A knowledge of the subject is expected, even though it is virtually ignored in the curriculum.

In a recent discussion with a high school principal,

himself well-trained in geology, I was told that the present generation of high school teachers is so poorly trained in geology that they evince no desire to teach earth science even though a demand for the course may exist. This fact was pointed out in 1949 by Mr. Templeton in "The Science Letter", a publication sent to science teachers of New York State. Supporting these opinions are the following data on the geologic training of earth science teachers in the state exclusive of New York City. The figures were sent to me by Mr. Donald B. Stone, an outstanding earth science teacher at Mont Pleasant High School in Schenectady. If these figures represent the geology training of teachers who give courses in earth science, think what the average would be if it included all science teachers or even all teachers of "general science", in which some geology is usually taught.

TABLE 1

Geological Training of Earth Science Teachers in Public Schools of New York State (exclusive of New York City)

Total number of earth science teachers	130
Total hours of preparation in geology	794
Average hours training in geology per teacher	6.1
Range in hours training per teacher	0-58
Number of teachers with no training in geology	54

If teacher training in science included more geology the subject would undoubtedly rise in prominence in high school curricula. In New York an applicant for the "physical science", or "all sciences", license need submit no geology or earth science credits. Likewise in Pennsylvania, certification of high school teachers prepared in any of the four divisions of science (biological science, physical science, science, and general science) is permitted without any training in geology.

Below is the science-teacher training program of Cortland State Teachers College in New York:

TABLE 2

Four-Year Program for Science Majors at Cortland State Teachers College, Cortland, New York.[2]

Education	36
Mathematics	6
English	21
Social Studies	18
Fine Arts	11
Elective	3
Health and Physical Education	11
Human Biology	3
General Biology	6
Physics	6
Chemistry	6
Earth Science	3
Science Elective	3
Outdoor Science, in Camp	3
Total	136
Total Science	30

How can a teacher inspire potential geologists if he has had but three hours of earth science in which geology is diluted with astronomy and meteorology? It is true that Cortland does not train senior high school teachers, but the situation at Albany State Teachers College, primarily for senior high school teachers, is worse, for here virtually no geology is offered.

Many aspiring high school science teachers receive the bulk of their science training in liberal arts colleges, and this fact may represent the white hope for high school geology training. If the faculty advisers of liberal arts college students who

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[2](Data from Thurber, W. A., "Science Without Terrors," The State University Newsletter, January 15, 1951). Numbers indicate semester-hours required.

anticipate a career as high school science teachers can be made cognizant of the importance of geology training, a major step forward will have been achieved. If the requirements for certification of science teachers can be changed to include at least six or eight hours of geology we will not have to argue with these advisers nor the curriculum chairmen of teachers colleges.

At the high school level, the substitution of geology for any of the present offerings in biology, chemistry, or physics would precipitate a battle that would do the field of geology no good. The substitution of earth science for general science--and not necessarily as a ninth grade offering--is logical and steps to bring this about should be studied. One way in which college geology teachers might help is by providing, at nominal or no charge, some of the necessary laboratory supplies. Summer and night-school offerings in geology by liberal arts colleges will certainly attract some high school science teachers. Much can be done to incite interest in geology on the part of high school teachers or their students by planning field trips to include them, developing geological museums, and addressing their science clubs and assemblies. Finally the Association of Geology Teachers should strive to increase its membership among high school earth science teachers. The meeting together of college and high school teachers will serve to maintain our interest in the common problem and result, I trust, in mutual stimulation.

EARTH SCIENCE IN THE SECONDARY SCHOOLS OF NEW YORK STATE[1]

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Earth Science, or Physical Geography as it formerly was called, has been taught in the schools of New York State for a great many years, and until shortly after the First World War it was a popular high school subject not only in this state but throughout the country. With the advent of General Science some of the teaching material of Physical Geography became absorbed in this subject, and there was a resultant decline in Physical Geography as a part of the curriculum of many schools. Less than one half of one percent of the total high school enrollment in the nation is now in Earth Science (or Physical Geography) classes as compared to nearly 30% in the year 1900. New York State, however, is one of the few states where this subject has never completely lost its identity. Even though the philosophy and objectives of education have undergone considerable change during the past half century, the study of Earth Science has remained in the New York State high school curriculum because of its recognized value in contributing to the general objectives of education. (Without digressing into what these objectives are, we can at least say here that our primary goal in teaching Earth Science is to educate our youth to a better understanding of their physical world with a resulting greater capacity for an enriched life.)

The committee that revised the Physical Geography syllabus a few years ago seriously considered integrating the subject matter of this field with that of other sciences, but concluded that there is justifica-

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[1]Read at the annual meeting of the Eastern Section, A.G.T., Rensselaer Polytechnic Institute, Troy, N. Y., April 3, 1953.

tion for offering a one-year course in Physical Geography. The name "Earth Science" was agreed upon as being more appropriate than "Physical Geography" since the new outline, as developed by the committee, included materials not commonly found in Physical Geography courses. The course is recommended for the eleventh and twelfth years. In some schools it is given every other year alternating with one of the other sciences.

The syllabus is intended as a broad outline or framework, within the scope of which local school systems may develop their own course of study adapted to the particular needs of the pupils and the community concerned. The Earth Science course suggested by the syllabus is divided into two terms of two units each. The first term is devoted entirely to geology, with one unit in physical and one in historical. The major topics that are considered in the physical geology unit include the structure and composition of the atmosphere, hydrosphere, and lithosphere; weathering; the action of groundwater, rivers, wind, glaciers, waves and shorecurrents; volcanism; and finally the origin and structure of plains, plateaus, and mountains. Special emphasis on the geology of the home area is recommended. The historical geology unit, which is at present optional, includes a study of past life and climates as shown by fossils and rocks; the age of sedimentary formations as indicated by their positions and fossils; evidences of great crustal uplifts followed by long periods of erosion; methods of estimating the age of the earth; and finally the geologic time scale as a summary of earth history. The relation of the geological processes to man is considered in both units.

The second term of Earth Science also consists of two units, namely astronomy and meteorology. The astronomy unit includes a study of the earth as a member of the solar system, the seasons, phases of the moon, eclipses, tides, latitude and longitude, and time. It closes with a study of the region beyond the solar system--the stars, constellations, and

galaxies--and ends with theories of the origin of the earth. The meteorology unit is a study of the elements of weather, general circulation of the atmosphere, air mass characteristics and fronts, construction of weather maps, weather forecasting, types of climate, and the factors that control climate.

The four units of the course are so arranged that the first and second terms may be taken as parallel courses in the same half year if the pupil's program requires it.

Laboratory and field work are an important part of Earth Science. New York State requires a minimum of 30 laboratory exercises. In many schools the pupils are equipped with individual sets of minerals and rocks which they handle and test for themselves. Topographic maps are used profusely in laboratory exercises on the study of physiographic forms. The reading of weather maps help to develop an understanding of the ways of the weather.

The registration in Earth Science has never been large as compared to that in other high school sciences. During the last few years, however, it has shown a slight increase in spite of the fact that the total high school enrollment in the state has been on the decrease during this time. The following figures give a general picture of the status of Earth Science in both the public and private schools of the state for 1952:

	Up-State New York	City of New York[2]	Total
Schools offering Earth Science	104	33	137
Classes in Earth Science	140	223	363
Earth Science teachers	104	37	141
Enrollment	2,864	7,199	10,063

[2]Data from article in High Points, December, 1952 (published by the New York City Board of Education).

During the school year of 1948-49 one New York school experimented with giving Earth Science to selected ninth year pupils in place of the usual ninth year general science course.[3] It was felt that if this experiment proved successful it would enable science-talented pupils to complete a four-year sequence in the advanced high school sciences. Many of our science-minded high school pupils find it difficult or impossible to fit all four of the advanced sciences into their crowded programs. The pupils for this experiment were carefully selected on the basis of interest, aptitude, and previous performance in science. Results were very good. Interest ran high throughout the year, and the class average in the regular Regents examination was well above the state average for all students in Earth Science courses. The above mentioned high school has continued offering Earth Science to selected ninth graders. Several (20) other schools are now trying the experiment, and still others are inaugurating the course next year. There is no feeling on the part of the State Education Department that Earth Science in general should be reduced to the ninth year level. This is simply a special arrangement for giving more of the advanced sciences to our specially talented pupils.

As stated above, the Earth Science syllabus was planned primarily for eleventh and twelfth grade students. However, it does not need to be confined to these levels. With the recent increase in ninth grade enrollment we find (September, 1952) that 19% of all Earth Science students are ninth graders; 21% are in tenth grade; 43% are in eleventh grade; and 32% are in twelfth grade. These figures are for upstate New York. In New York City Earth Science is confined almost entirely to the eleventh and twelfth grades.

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[3]See "Earth Science for Ninth Year Students", Science Teachers Bulletin, spring, 1950. (Published by the New York State Science Teachers Association.)

GEOLOGY AND SCIENCE TEACHER TRAINING: AN OPPORTUNITY

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Proper and adequate training for the secondary teacher of science has been debated at least since training in subject specialty was questioned and training in educational method substituted. Much has been written critical of the results of policies of the last thirty years, and apparently little accomplished.[2] One reason may be that detailed proposals have not often accompanied critiques. Neither have writers generally given due credit for the contribution professional educators have made to science teaching methods in the same thirty year period. This paper will not consider the merits of the scientists' insistence that "to specialize in the particular science he or she plans to teach . . ."[3] is the first and absolute requirement. It will attempt to show, first, that geology can develop, more readily than other physical sciences, a middle ground between the two extreme viewpoints of the scientist and the professional educator; and, second, it will suggest a specific program for such teacher preparation in a normal four-year college course.

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[1]Manuscript received October 14, 1952. Dr. Webb is now Executive Director of the American Geological Institute, and Executive Secretary, Division of Geology and Geography, National Research Council.

[2]See unpublished study by Orton, Don A., "Appraisal of the Programs of Academic Specialization of Utah's High School Teachers," thesis, Harvard Graduate School of Education, 1950. Cited by Watson, Fletcher, in Communications to the Editor, Science, n.s., vol. 116 (1952), pp. 261-63.

[3]Schriever, William "Teacher Training" Science, n.s., vol. 115 (1952), pp. 96-98.

Scientists must face the facts (1) that very few physical science majors with specialized training are now entering the teaching profession at the secondary school level; (2) that teachers in the secondary system are teaching physical science willy-nilly although they have not had such training; and (3) that prospective secondary teachers are majoring in the fields of physical science and mathematics in ever-decreasing numbers. Some of the qualities required in the mental makeup of people attracted to the physical sciences for professional specialization are unique. Such individuals must (1) enjoy the thrill of discovery on inanimate or non-human subjects, (2) experiment long and tedious hours with "things", often with repeated maddening failures before success rewards, (3) seek more and more quantitative methods and results. Unfortunately most persons attracted to secondary teaching tend to see physical science specialization as (1) dull, because it does not deal directly with human beings, (2) without promise of at least partial success in the way that work on, with, and over human beings promises success, and (3) overly "mathematical".

Irrespective of the merits of these opposed viewpoints, the area of physical science offering the greatest opportunity of mediating between them, with the potentially constructive effect of having more students train for science secondary teaching, seems to be geology. Geological science is less susceptible to the objections raised by prospective secondary teachers to physical science in general because earth science is more descriptive (less quantitative) and because its relation to the activities of human beings is more readily, and often more interestingly, demonstrable than in other physical sciences. Therefore earth science can more effectively catch the interest and attention of undergraduates planning on secondary teaching.

Cooperation of all physical scientists is required if able students headed for secondary education are to be induced to investigate and select a physical

science major. Recognition of the need for science teacher training, a realistic view that a reduced subject dose is better than none at all, and respect for students who take science training on an other than professional basis are required. Unfavorable comparisons with "able students in my field" must be abandoned, especially if the only sins are breadth rather than depth of interest, and average rather than exceptional ability in mathematics.

Cooperation of professional educators must be gained. It cannot be, however, if scientists are patronizing and grudging about the necessity of sitting together at the conference table with these men. Only by genuine respect for what professional educators have accomplished and by subduing criticisms which, though often justified, have been so frequently voiced that they are platitudinous, can this cooperation be gained and maintained. A sincere effort on the part of scientists to understand the professional educator's point of view might result in mutual enlightenment, and greater mutual respect. I believe that such cooperation is possible, and that both education and science wish to improve an area of admitted weakness, where discussion has as yet produced too little fruit.

The restrictions placed on the prospective science teacher's schedule by state teacher-accrediting agencies must be recognized, and, for the time being at least, accepted. It is certainly foolish to blame the Education Department of your institution, or individual members of its staff, for the ills of our present system of teacher-accreditation.

In their junior and senior years most college students take from 24 to 42 units in the "field of concentration" or "major", 18 to 24 units for "distribution" or "minors", and "electives" to total approximately 60 units. In their freshman and sophomore years they take 60 units of work in major, minor, and general education courses. By careful planning of a special program in physical science, more prospective secondary school teachers can be pursuaded to con-

centrate in this field. Such a program might read as indicated in Table 1.

TABLE 1

Physical Science Major for Prospective High School Teachers

First Two Years

	Fresh.	Soph.
English	3	3
History	3	3
Geography	3	3
Chemistry	4	4
Physics	4	4
Geology	4	4
Mineralogy		4
Totals	21	25 units

Second Two Years

	Jun.	Sen.
Regional geology	3	3
Geomorphology, or advanced physical geology		3
Paleontology	3	
Economic geology	3	
Geology elective		3
Chemistry or physics	4	4
Biological science	4	4
Social science	3	3
Totals	20	20 units

Professional courses as required in education (up to three year courses in the last two years, or scattered through the four years) may be fitted to this schedule

in most schools. With eighteen hours of education this program totals 104 units, with 30 units in geology, 24 in chemistry and physics, and 8 in biological science. Since 120 units are commonly required for a B.A. degree and 124-128 for a B.S., the proposed program fits normal situations.

A major in physical science using geology as a springboard offers a practical combination of usable and acceptable courses. Most programs for physical science majors as defined by state accrediting agencies permit a combination of earth science, chemistry, and physics as suggested in the program.

Colleagues in physics, and to a lesser extent in chemistry, will protest that students cannot be expected to pursue junior and senior geology courses without college mathematics and additional preparation in physics and chemistry. On the other hand, a recent paper on this subject[4] pleads "We scientists in our respective colleges must plan and offer courses in science for public school teachers at appropriate levels of difficulty and completeness." Most institutions that have experimented with physics and chemistry courses for the non-specialist not only have found them successful, but have agreed that offering such courses without the mathematics required of professional specialists does not lower the quality of the offering, though it of necessity must change content. Often instructors, forced to express concepts nonmathematically, gain new insights into their own fields, by having to interpret descriptively and qualitatively.

It is important to remember that a good teacher-training program in science, if initiated on a large scale[5] now, will begin to show measurable results not

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[4]Schriever, op. cit.

[5]Harvard University through its Graduate School of Education has such a program for a select and limited number of students.

sooner than ten years afterwards. The longer college science professors continue merely to deplore the poor preparatory training which their prospective majors have received in secondary schools, the poorer the training will become and the fewer students will engage in science. Let's stop deploring and start doing. Though the proposals offered here are not educational panaceas, the Association of Geology Teachers might do well to adopt a program designed to further this cause as one of its major projects. Geology may well be the 'open sesame' to success in better science teaching in secondary schools.

THE ORGANIZATION AND OPERATION OF CAMP NORTON

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History. Camp Norton bears the name of the eminent founder of the Department of Geology at Cornell College, Dr. William Harmon Norton. It was established in 1940 by the late Neil A. Miner of Cornell College and David M. Delo, then head of the Department of Geology at Knox College. Syracuse University was added as a participating institution in 1945, as was Miami University in 1947. Syracuse University severed its ties with the camp in 1949. In 1950 Mississippi State College became a participating institution. Knox dropped out in 1951.

Location and facilities. Timberline Ranch, the base of operation for Camp Norton, is located fifteen miles up the valley of the Wind River from Dubois, Wyoming. It is privately owned and was formerly a dude ranch. The camp's facilities, which are provided by Timberline Ranch, consist of dormitory-type sleeping quarters for the students, a double bath-house, a large dining room, kitchen and recreation room in the main ranch house, and double cabins for the staff. The ranch also provides the food service, including meal preparation by a professional cook.

Working agreements. Camp Norton is founded on a gentlemen's agreement among the participating schools and the ranch owner. The only written agreement is among the participating schools. It provides that each school shall (1) furnish an instructor, (2) provide transportation for its students, (3) pay the ranch owner $300 rent a year, (4) register twelve or

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[1]Cornell will not participate in the operation of Camp Norton in 1953. This paper was written and submitted to the Journal in the spring of 1951. It has been brought up to date by revision in the spring of 1953.

thirteen students per term, and (5) require its instructor and each of its registrants to pay the ranch owner $85.00 per term for room and board.

The ranch owner's investment in the camp facilities is reasonably protected by these agreements. Similarly, the participating schools are assured of a base of operations by the owner's earnest desire to serve the field course adequately.

These arrangements are extremely satisfactory from several points of view. If the schools were to build or buy a field camp base with facilities similar to those of Timberline Ranch, it is estimated that an expenditure of approximately $30,000 would be required. The interest on such an investment would be more than the rent paid yearly by the participating schools. In addition, if the schools owned their own camp, they would have the expense and responsibility of maintaining a vacant camp through ten months of every year.

The present agreement also makes the ranch owner fully responsible for the housing and feeding of the students and staff. This arrangement is certainly satisfactory for the instructors, as it permits them to devote their full time and energy to the educational program.

Transportation. The present agreement among the participating schools does not specify the means of transportation which each institution shall furnish. During the first few years of operation, private automobiles and station wagons owned by the participating schools were used. The wagon provided by each school transported its instructor and seven students. The remaining five students from each school were transported by private automobile. The cost of field operation and maintenance of each station wagon was approximately eight cents per mile. Students who provided automobiles were paid seven cents per mile for field transportation.

The use of private automobiles was unsatisfactory for the following reasons: (1) after a week or so of travelling field roads, the owners usually decided that field travel caused undue depreciation of their automobiles; (2) too many vehicles were involved in daily field travel; and (3) student-mile transportation costs were higher for private automobiles than for the college-owned vehicles. During 1951 and 1952, light trucks equipped with stake bodies, tarpaulin tops, and removable seats were used. One-ton trucks can carry approximately fourteen passengers in addition to the driver. A truck from each school provides transportation for its entire group. Trucks have proved to be more serviceable over the poor roads and rugged terrain than were the station wagons and private automobiles.

Courses offered. Two terms of four weeks each are offered at Camp Norton during July and August. The courses have been developed by the participating departments of geology to fit the needs of their own students. Students from other schools are, however, accepted. Both men and women may attend.

Three levels of instruction are offered. Six semester hours of credit are granted for each course. Opportunity is also provided for individual research on thesis problems.

The elementary course is an Introduction to Physical and Historical Geology. This is a general education course designed to meet the "laboratory science" requirement of many liberal arts colleges. There are no prerequisites. Cornell College does not accept this course as a substitute for the standard introductory geology course in preparation for later specialized courses.

Fundamentals of Field Geology is the most important course. Prerequisites are Physical and Historical Geology (the standard introductory course offered during the regular school year.) Its content is as follows: The first six of the total of twenty-eight

days (four weeks) available are devoted to an introductory discussion of (1) basic principles of stratigraphy, (2) use of the Brunton compass and determination of distance by pacing, (3) recording of observed data, and (4) use of base maps. The next four days are devoted to topographic mapping in the field. This is followed by ten days of intensive study and mapping of the geology of the Dubois area, plus four days devoted to the solution (by the students) of special problems in adjacent areas. All students are required to take a written examination and turn in a report.

The Advanced Field Geology course is open to students who have had at least one year of advanced course work in geology and some field experience. The area where this course is given is rather complex geologically, and there are no base maps available. Consequently each party must prepare its own base map by the use of the alidade, aerial photographs, and pace and compass traverse. In addition to general mapping and interpretation of the geology of the area, each party is given a special project to work on--such as the glacial features, a conglomerate, or a particular fault. "Co-ordination sessions" are held several nights a week. These meetings give the students an opportunity to compare notes and discuss procedures and hypotheses. They serve to co-ordinate the activities of the various parties. The course is designed in particular to increase the students' initiative and self-reliance in the field and to introduce the principles of co-operative field work.

Instructional techniques. When students register for either the Fundamentals of Field Geology or the Advanced Field Geology, they submit a record of their geological training. Each party consists of three or four students, from different schools if possible, who have comparable backgrounds. This grouping encourages each student to work at the highest level of his ability. The party system also enables the instructors to better supervise such a large number of students. Generally it is necessary, after the first few days in the field, to make a few changes in the personnel

of some of the parties because of the failure of the party members to work together.

Each party is issued at least one Brunton compass. All students keep their own notes and maps. They are all encouraged to make their own observations and interpretations. Notebooks and maps are checked weekly for errors and points of weakness. This is usually done at one of the bi-weekly night sessions, when a critique of the current work is undertaken. During these sessions, the students are also briefed on future work.

Each instructor has charge of approximately three parties. From day to day the instructors rotate among the parties, so that each student has contact with all instructors. In addition, each instructor assumes full responsibility for teaching certain aspects of the field work for which he is better prepared than are the other instructors. Each student party is assigned a definite time to appear at the particular field location where the qualified instructor presents an analysis of the problem and directs the party in its study thereof. Meanwhile other parties are working on the more routine assignments under the direction of other instructors.

Grading. At the end of each term the students take a comprehensive written examination of approximately two to two and one half hours' length. A written report is also required. In addition, the instructors jointly submit a grade for each student, based upon the quality of his field work. The field work grade, the examination grade, and the report grade determine the student's final grade for the course.

Our experience at Camp Norton indicates that a minimum prerequisite of introductory physical and historical geology is sufficient for a course in basic field methods. Students with such a minimum background profit immensely from the field experience. It provides an excellent frame of reference for future course work—especially in such subjects as structural geology and

sedimentation. On the other hand, students who already have a broad background of specialized course work find in the basic field course a testing ground for their knowledge. We find in many cases, however, that the student with minimum preparation is actually a better field observer.

TEACHING THE HISTORY OF GEOLOGY[1]

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Aristotle is often quoted as having said, "He who sees things grow from the beginning will have the best view of them". Auguste Conte is quoted, "I am certainly convinced that the knowledge of the history of the sciences is of greatest importance. Indeed I believe that one does not know a science insofar as he does not know its history".

Geikie in 1905 wrote, "In science, as in all other departments of inquiry, no thorough grasp of a subject can be gained unless the history of its development is clearly appreciated".

There is little that can be added to the words of these great men except to point out that what they have said is as true of geology as of any other science, and that a knowledge of the history of geology is of value to the geologist. The great mass of geologic information and the many geologic ideas and theories take on more significance, as well as more interest, when the background of their development and accumulation are seen in proper perspective.

Most geology teachers introduce some of this historical material in normal course work, but it is there presented in relation to the subject matter and not identified with its own historical, social, economic, or scientific background. Many ancient ideas are seemingly ridiculous viewed in the light of present knowledge, but when placed before a backdrop of their own time they may stand out as brilliant contributions. Accordingly it seems desirable to present the history of geology as a unit.

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[1]Presented at the annual meeting of the Central Section, A.G.T., at Iowa State College, April 11, 1953.

There are various ways of approaching the history of geology:

1. History of separate branches: i.e., mineralogy, paleontology, etc.
2. History of ideas and concepts: i.e., evolution, uniformitarianism, etc.
3. History of personalities.
4. Chronologic approach, in which an attempt is made to integrate the history of the several branches with the development of ideas and personalities responsible for the ideas. This approach should also integrate the developments in geology with those of other sciences and with events in world history.

The chronologic approach is admittedly the most idealistic and the most difficult, but if well done it is by far the most satisfactory.

If the fourth approach is used, the history of geology can be divided into chapters which more or less parallel world history as follows:

Classical times, 635 B.C. to 50 B.C.
Early Greeks
Later Greeks
Early Romans
Roman Empire, 50 B.C. to A.D. 500.
Dark Ages, 500 - 1100.
Middle Ages, 1100 - 1450.
Renaissance (birth of modern geology), 1450 - 1600.
Development of modern geology, 1600 - present.

Classical times. The time of the early Greeks was one in which there was great freedom of thought and of expression. Intellectual pursuits were held in high esteem and there was much encouragement given to the enquiring mind and the thinking person. This is the time which produced so many famous Greek scholars and philosophers, and it is surprising to many to learn that some of these concerned themselves with things geological. For example, Thales, one of the

earliest, was acquainted with the Nile Delta, its method of growth, and the effect of the waves upon its shores. Anaximander saw the comparative relationships between man and fish. Herodotus recognized that the seas had once been of greater extent. Aristotle, the greatest of the Greek naturalists, knew the earth to be round. There were many more scholars of this time but there is not space here to enumerate them.

Roman Empire. The Roman was primarily a man of affairs. Business, law, and military strategy were the prevailing interests of this time. Consequently there was a great neglect of the sciences and we find only a few contributors to geological thinking. Probably the most outstanding are Lucretius, Vitruvius, and the elder Pliny.

It is almost astounding to note that up to this time not a single writer had examined the rocks with a view to ascertaining their composition.

Dark Ages. This bleak period in history is essentially barren of geological thought. Apparently there was no time nor inclination for scientific study. Most European peoples were content to have things explained in terms of "powers, virtues, and influences". Fear and superstition reigned supreme.

The Arabs however were not so greatly affected by the Dark Ages, and fortunately they were able to preserve the ideas and writings of the Greeks. Among the Arabs, Avicenna stands out as being the most "geologically minded". He observed that many mountain ridges and peaks are the remnants of resistant rocks left by erosion of less resistant ones. He also noted that marine deposits could be found in the mountains.

Middle Ages. The years from 1100 to 1450 saw the dawn of better things, but the thinking of the time was dominated by fear and superstitions inherited from the Dark Ages. Probably the most influential thought control of the period was the Ptolemaic concept of the universe. Progress in geology was

stymied by the dominance of the philosophies of the microcosm and the macrocosm, the doctrine of signatures and correspondences, and by the great belief in powers, influences, and virtues of the heavens. Even though the Ptolemaic concept did embody certain elements of truth, the theologians wove into it a web of fancy which had a deep and harmful effect on human thought. The writings of Albertus Magnus, and Ristoro d'Arezzo reveal some interest in geological phenomena, but provide explanations so far-fetched as to seem almost ridiculous.

The Renaissance (Founding of Modern Geology). The travels of the Crusaders, the travels of Marco Polo, and the spreading of Arab culture, opened new horizons to the minds of Europe, and there was a great revival in all phases of learning. This revival is well evidenced by the fact that Emperor Frederick II had brought into Catholic Rome, Moslem and Jewish philosophers to aid in enlightening his people. The stage was set for the arrival of such workers as DaVinci (the father of modern geology); Steno; Agricola; Palissy; and Descartes--all of whom contributed much to the development of geology as a science.

Across the channel in England there were some thoughts of geology. In the days prior to 1700 the works of Robert Hooke, Thomas Burnet, John Woodward, and Robert Plot showed an interest in geology. Robert Hooke is probably the outstanding geological figure of the 17th century, and is well remembered for being the first to apply the compound microscope to the study of fossils. However, most of their thinking was of cosmogony and there was no interest in making personal observations or actually studying natural phenomena. The influence of the theologians is sharply demonstrated in the writings of Lister, who published a remarkable history of shells in which he used fossils for comparison, though he still refused to believe that the fossils had ever been parts of living organisms. Lister will probably be remembered as the first person to suggest a geologic map.

Development of modern geology. In France and Germany during the 18th century there were several students who had become well versed in mathematics and physics and who turned their interest to the Earth. Probably the outstanding of these were Guettard and Werner.

Guettard was a true naturalist, a patient observer, who did much work of great brilliance, but who has been largely overlooked because of the ponderous nature of his writing. It was Guettard who made the first mineralogic map. Probably his greatest claim to fame is his recognition of the old volcanoes in the Auvergne district of France.

Abraham Gottleib Werner probably looms larger in the history of geology than any of the men yet mentioned. He probably did more to retard the progress of the science than any other. The great school of Wernerism, established on the false beliefs of "Neptunism", was a great deterring factor in the development of a true and scientific study of rocks and minerals, and particularly of historical geology. Its effect was felt in this country into the middle of the nineteenth century.

A significant year of the eighteenth century was 1769, during which time the voyages of Cook, and the Russian expeditions under Simon Pallas, were made for the purpose of observing the Transit of Venus. These marked the beginning of travel for scientific purposes and thereby the real beginning of geological travel.

Toward the close of the eighteenth century, and extending into the nineteenth, were the works of Lamarck, Cuvier, Brongniart, William Smith, James Hutton, John Playfair, and von Buch. The effect of these workers on later developments in geology are well known. Also by this time chemistry and physics had become established sciences and were proving to be of great aid in geological problems.

The events of the closing years of the eighteenth century were so closely related to those of the early part of the nineteenth that it is difficult to recognize a sharp separation. Also the development of geology in colonial America is so closely tied to events in Europe that the work of the two centuries merge in continuity.

Geikie, in referring to the developments of this time, points out how late men were in realizing that the knowledge of earth history must be based on patient investigation of the evidence presented in the earth itself. It remained for James Hutton to state this principle in his Theory of the Earth, published in 1795. The effect of his "Law of Uniformitariansim" was to cause a great change in the geological thinking, which actually opened the way for modern historical geology to develop.

Early American geology. In teaching the history of geology in American schools it is only natural to shift the emphasis to events in this country, but care must be taken not to overlook the very important developments in Europe, particularly France and England. The works of DeLaBeche, Murchison, Sedgwick, Lyell, Geikie and Lapworth are indeed classics.

Early American geology has been divided into eras by Merrill as follows:

Maclurean Era	1785-1819
Eatonian Era	1820-1829
Era of the State Surveys	
First decade	1830-1839
Second decade	1840-1849
Third decade	1850-1859
Fourth decade	1860-1869
Fifth decade	1870-1880
Era of National Surveys	1854-1879

Inasmuch as Merrill's history is so complete the details of these years will be only briefly reviewed. To Merrill's outline should be added, however, an

initial unit of colonial or pre-Maclurean geology. Knowledge of this time is somewhat limited but is gradually being brought to light by the work of George W. White. Most of the work of the time was of an economic nature. Many of the early colonial expeditions had their "mineral men".

After the Revolutionary War a need developed for greater knowledge of the country's mineral resources, and the getting of this knowledge was largely undertaken by the states. It was a difficult undertaking because money was not plentiful, and there were no trained geologists in America. No geology was being taught. Good base maps were not available. Even as late as 1800 there was not a geology department in any school in the country. Despite these conditions there were many in the early 19th century who became interested in geology and, by self-teaching, became leaders. Among these we find Amos Eaton, James Hall, Ebenezer Emmons, Benjamin Silliman, Parker Cleaveland, and many others. It is almost amazing, however, to find that as late as 1830 the textbooks still mentioned the Noachian Deluge as an important geologic event.

As the populace prospered, more time and money became available for scientific work and many keen minds were turned to geologic problems. Schools established courses in geology and geological societies were formed. By 1840 geology was in the curriculum of the leading colleges of the land.

State governments began to realize the need for state supported surveys. These began with the efforts of the Carolinas in 1824, and between 1830 and 1839 fifteen other state surveys were established.

Westward expansion demonstrated the need for more knowledge of the west, and expeditions, some of them under federal supervision, were organized. Many of these were basically geographic in nature but some geologic work was included. The discovery of gold in California and the subsequent westward migrations created a demand for a cross-country railroad. To

build this road a route had to be surveyed, and several expeditions were formed to make preliminary surveys. These generally included a geologist.

The Civil War nearly paralyzed geologic investigation, but its abrupt end left the country with a good supply of rough and ready, outdoor-loving, daring men, eager and able to make the needed expeditions. These expeditions, under the leadership of such eminent men as Hayden, King, Powell, and Wheeler, accomplished great things. Out of them grew the U.S. Geological Survey, which was established in 1879.

The history of geology since that time is more commonly known and the founding of the U.S. Survey is not a bad point at which to terminate a history course. However, if time allows, there are many recent developments which merit treatment. For example, it is surprising to many to learn that geophysical exploration had its inception in gun-locating devices of World War I. Aerial photography, now a routine process, is less than 25 years old. Military geology was officially recognized in World War II, but is probably yet in its infancy.

There are many other developments of the present century which are worthy of time spent on them, but the big gap in the background of most students is in the earlier history of the science.

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